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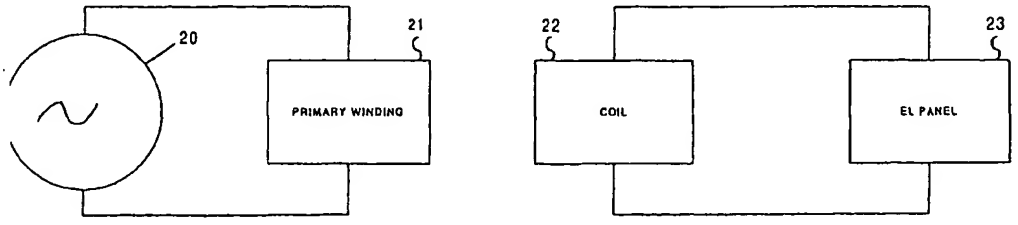
(54) Title: INDUCTION ELECTROLUMINESCENT LAMP



(57) Abstract: An electroluminescent lamp (23) obtains electrical power from a secondary, self-contained wire or other coil (22). The self-contained coil is energized through mutual induction with a physically separated primary coil (21). The secondary coil (22) behaves like the secondary windings of a transformer. The primary coil (21) may be mounted into/onto a table, tablecloth, place mat or some other item. When the EL lamp (23) (with integral secondary coil (22)) is placed in close proximity to the primary coil (21), which is supplied with AC or pulsed DC, electrical energy is transferred from the primary coil (21) to the secondary coil (22). Thus, this system mimics an air gap transformer with the EL lamp (23) serving as a load on the secondary's output. The system powers an EL lamp (23) with no visible means of electrical connection.

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INDUCTION ELECTROLUMINESCENT LAMP

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to power supplies for electroluminescent lamps.

Description of Related Art

Electroluminescent (EL) lamps are light sources that contain a special phosphor or combination of phosphors that luminesce when they are subjected to electric fields. Typical EL lamps are powered by an alternating current or pulsed DC power supply. The lamps' brightness and color directly relate to the voltage and frequency of the lamps' power source.

Conventional EL lamps require their power source to be physically connected to the light emitting elements through a wire or some other physical connection. This increases the size and cost of each individual lamp, and in some situations, is awkward.

Prior art lighting devices have used magnetic induction to energize inert gases, causing the gas to give off light. These devices are limited, however, because the inert gas must be constantly hermetically sealed, which tends to make the devices fragile. Additionally, inert gas devices are limited in their ability to be patterned into interesting and/or recognizable shapes.

SUMMARY OF THE INVENTION

One object of the present invention is to create an EL lamp that does not have to be physically connected to its power supply. The absence of physical contact in the present invention reduces corrosion and breakage associated with connecting conventional EL lamps to their power supply.

A second object of the present invention is to allow multiple EL lamps to be easily and quickly interchanged with a single power supply.

The advantages and purpose of the invention will be set forth in part in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The advantages and purpose of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the appended claims.

To attain the advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, the invention comprises an electroluminescent (EL) lamp powered by a coil forming a secondary winding of a transformer.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate several embodiments of the invention and together with the description, serve to explain the principles of the invention. In the drawings,

Fig. 1 is a high level block diagram of an electrical circuit used in the present invention;

Fig. 2a shows a top view of an electroluminescent drink coaster according to one embodiment of the present invention;

Fig. 2b shows a side view of an electroluminescent drink coaster according to the first embodiment of the present invention;

Fig. 2c shows an interior view of an electroluminescent drink coaster according to the first embodiment of the present invention;

Fig 3 is a diagram illustrating a practical application of the present invention;

Fig. 4 is a side view of another embodiment of the coil element according to an embodiment of the present invention;

Fig 5 illustrates another embodiment of the coil element according to an embodiment of the present invention;

Fig. 6 shows an end use application example: Inductive Poker Chip;

Fig. 7 shows a method for printing inductive coil—shape variation;

Fig 8 illustrates a Method for Sequencing Inductive Coils for Powering an Inductive EL Assembly;

Fig. 9 is a diagram of the sequencing inductive coils;

Fig. 10 is a diagram of a method for producing additional wraps/windings using printed coil assembly;

Fig. 11 shows an end use example—an inductive tent display for a room;

Fig. 12 shows detail of the tent display;

Fig 13 illustrates another end use application example—an inductive credit card;

Fig 14 shows the related end use application example—a restaurant credit card holder;

Fig. 15 shows an end use application example—an inductive coil can.

DESCRIPTION OF PREFERRED EMBODIMENT

In the present invention, an electroluminescent lamp obtains electrical power from a secondary, self-contained wire or other coil. The self-contained coil is energized through mutual induction with a physically separated primary coil. The secondary coil

behaves like the secondary windings of a transformer. The primary coil may be mounted into or onto a table, tablecloth, place mat or some other item. When the EL lamp (with integral secondary coil) is placed in close proximity to the primary coil, which is supplied with an alternating current (AC) or pulsed direct current (DC), electrical energy is produced in the secondary coil. This energy flows between the electrodes in the electroluminescent lamp, inducing the electroluminescent material to luminesce. The lamp's light producing material may be arranged in aesthetically pleasing patterns.

Fig. 1 is a block diagram of the electrical circuit used in the present invention. In Fig. 1, AC (or pulsed DC) power source 20 is coupled with primary winding, or coil, 21. Primary winding 21 and coil 22 together function as a transformer. Coil 22 is connected in a series with an EL lamp 23. Power supply 20 energizes primary winding 21 that in turn creates a current in coil 22, and thus EL lamp 23, which illuminates EL lamp 23.

The color and intensity of the light emitted from the EL lamp 23 depends on the frequency and magnitude of the voltage driving the EL lamp 23. The frequency of the driving voltage depends on the frequency of power source 20. The magnitude of the driving voltage depends on the voltage of the driving source or the size of the primary winding relative to the coil 22.

Figs. 2a-2c show a top, side, and interior view, respectively, of an electroluminescent drinking coaster 30 according to one embodiment of the present invention. Fig. 2a, the top view, shows an EL lamp emitting light spelling "ADD VISION"™ owned by Add-Vision, Inc. Fig. 2b, the front view of the coaster 30, shows a first layer 31 and second layer 32. First layer 31 contains all the elements of the EL lamp necessary for luminescence, except the power supply. Second layer 32 contains a coil 38 for providing electrical energy to first layer 31. Coil 38 has terminal leads 36 and 37 for coupling the power induced in coil 38 to the first layer 31.

Fig. 2c is an interior view of coaster 30 taken through coil layer 32, showing a spiraling coil with leads 36 and 37.

Preferably, coil 32 is a printed conductor (e.g., metal filled ink), but it may also be an adhesive bonded foil conductor, a wire conductor, etched circuit, or some other electrically conducting material that serves as a coil. Coil 32 is also preferably cylindrical, but may be serpentine, helical, zigzag, or any other shape appropriate for obtaining mutual inductance with the primary winding.

Fig. 3 is a diagram illustrating a practical application of the present invention in which a physical barrier, such as a table, is placed between the power supply and the EL lamps. One or more coasters 30 constructed according to the present invention are placed on the table 41. Power supply 43 is attached to the underside of the table and contains the primary windings of a transformer. The coasters 30 are powered through mutual inductance with power supply 43, preferably connected to a wall outlet through cord 44. One may freely move or replace the coasters 30 without concern for the power supply to the coasters.

Fig. 4 is a side view of an embodiment of a coil element according to the present invention. Coil element 50 contains multiple layers of coils 51, 52, and 53, each similar to the coil element shown in Fig. 3. The coils 51, 52, and 53 are formed in layers in insulating material 55 and are coupled with each other at their ends to form one larger coil. Terminal leads 56 and 57 are coupled to an EL lamp (not shown).

Fig. 5 illustrates a coil element 60 formed with two insulating wires 61 and 62 intertwined and shunted together at point 63. The terminus 64 of wire 62 and the terminus 65 of wire 61 are connected to an EL lamp (not shown).

Fig. 6 shows an EL inductive poker chip. A printed or wound secondary coil 9 is attached to a bottom substrate 10. An insulator 8 is positioned between the secondary

coil 9 and a rear electrode 7. A dielectric layer 6 and an electroluminescent phosphor layer 5 are placed between the rear electrode 7 and the front electrode 4 which is made of Indium Tin Oxide on PET, so that it is transparent. A silver bus bar 3 is printed onto the front electrode 4. A graphic overlay assembly 2, including transparent or translucent ink 1 makes up the top layer of the poker chip. When the chip 11 is brought near the printed or wound primary coil 13 the phosphor in the chip is induced to luminesce. The primary coil 13 can be placed beneath a poker table 12.

Fig. 7 shows a method for printing the inductive coil.

Fig 8 illustrates a method for sequencing inductive coils for powering an inductive electroluminescent assembly. The electroluminescent lamps 1 are attached to individual secondary coils 3 by way of printed silver trace 2. The primary coils 4 are electrically connected to a microprocessor or micro-controller 5 for sequencing which is in turn electrically connected to a power supply 6.

Fig. 9 is a diagram of the sequencing inductive coils. The electroluminescent lamps 1 are electrically connected to the secondary coils 2. The primary coils 3 are connected to switches (for example, TRIAX or Opto) 4 and then to a microprocessor switching assembly 5. The switches 4 are electrically connected to an inverted power supply 7. A battery 9 with a power switch 8 is electrically attached to the inverted power supply 7, the microprocessor switching assembly 5, and the switches 4. If necessary an in-line capacitor 6 can be included in the circuit.

Fig. 10 is a diagram of a method for producing additional wraps/windings using printed coil assembly. Pole 1, labeled 1, on a coil is connected through connection 2 through dielectric layer 3 to another coil which in turn is connected by connection 4 to another coil. This coil is attached by connection 5 through dielectric layer 6 to yet another coil. Pole 2 is labeled 7. A substrate 8 is attached to the coil assembly.

Fig. 11 shows detail of an end use example—an inductive tent display for a room. A cardboard tent-shaped substrate 1 is printed with color 8. A window in the substrate contains an electroluminescent lamp assembly. The bottom layer of the electroluminescent assembly is a layer of silver 2. This is the bottom conductor. A layer of white dielectric 3 is positioned between the silver layer 2 and the phosphor layer 4. A transparent or translucent printed top conductor 6 lies over the phosphor layer 4. A silver bus bar 5 is printed onto the top conductor 6. Transparent or translucent ink 7 is printed onto the top substrate. Silver traces 9,10 run from the electroluminescent lamp assembly to a secondary printed or wire wound coil 11. Primary coil 12 is enclosed in PET 13,14 or another substrate layer with printed color 8 on the top. The bottom layer of PET 14 is attached to mounting adhesive 15 and an adhesive layer 16. The primary coil 12 is electrically connected to an inverter 19 through two AC power lines 17,18. The primary coil and power supply can be mounted to a table or other fixture in a room. When the tent shaped display is brought close to the primary coil the phosphor in the lamp is induced to luminesce.

Fig. 12 shows the inductive tent display for a room. The cardboard substrate 1 is shown to be tent-shaped. Electroluminescent lamp 20 is lit when secondary coil 11 is brought near to primary coil 12, which is enclosed in layers of PET 13,14. A power cord 21 connects the primary coil to power inverter 19, which is connected to a power cord 22 and plug 23.

Fig 13 illustrates another end use application example—an inductive credit card. The secondary or receiving coil 8 is enclosed in the card 7. It is connected to an electroluminescent lamp assembly which is also enclosed in the credit card. The electroluminescent lamp assembly comprises a rear electrode 3, a phosphor layer 2 and a top electrode 1. The primary coil 4 is enclosed in a capacitor assembly 5 along with an

inverter 6. When the credit card 7, is brought near to the capacitor assembly 5, the phosphor in the card is induced to luminesce.

Fig 14 shows a related end use application example—a restaurant credit card holder.

Fig. 15 shows a further end use application example—an inductive coil can. An electroluminescent lamp assembly 1 is included in the label of a can. A secondary or receiving coil 2 is electrically connected to the electroluminescent lamp assembly 1. A printed insulator 3 means the electrical connection can connect each end of the coil to the lamp independently to create a circuit. The label of the can assembly 4 will light up when brought into close proximity with a primary coil.

It will be apparent to those skilled in the art that various modifications and variations can be made to the present invention and in its construction without departing from the scope or spirit of the invention. As an example, an iron or other metal based core may be placed between either one of the coils to increase the inductive coupling. As a second example, the coil may be substituted for the lamp's rear electrode, thus simplifying construction and minimizing parts. Additionally, although the preferred embodiment was demonstrated as a drinking coaster, the number of possible applications is practically limitless. For example, the present invention may be used with easily changeable luminescent panels shaped as letters for billboards and marquees. In another example the invention may be used with a board game such that the playing pieces or other parts are illuminated when placed on particular parts of the board.

Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples be considered exemplary only, with the true scope and spirit of the invention being indicated by the following claims.

WHAT IS CLAIMED IS:

1. An illuminable apparatus comprising:

an electroluminescent (EL) lamp that illuminates when supplied with an alternating voltage;

a first coil formed as an integral part of the EL lamp.

2. The apparatus of claim 1, wherein the first coil includes means to receive electromagnetic energy and to convert the electromagnetic energy into electric power.

3. The apparatus of claim 2, further comprising a second coil, physically separate from the first coil, the second coil generating the electromagnetic energy received by the first coil.

4. The apparatus of claim 3, further comprising a power supply electrically connected with the second coil.

5. The apparatus of claim 1, wherein the first coil and the second coil are the same or different and each independently comprise one of a printed conductor, an adhesive bonded foil conductor, and an etched circuit.

6. The apparatus of claim 5, wherein the first coil and the second coil each comprise a printed conductor.

7. The apparatus of claim 1, wherein the first coil and the second coil each comprise a concentric isoplanar spiral.

8. The apparatus of claim 1, wherein the first coil and the second coil each comprise a set of isoplanar parallel zigzag lines.

9. The apparatus of claim 1 wherein the EL lamp comprises a transparent or translucent layer, a light producing layer, and a rear electrode.

10. The apparatus of claim 9, wherein the transparent or translucent layer is an optically transparent polyester thin film and the light producing layer includes an electroluminescent material.

11. The apparatus of claim 10, wherein the electroluminescent material is zinc sulfide phosphor.

12. The apparatus of claim 1, wherein the EL lamp is constructed as a drinking coaster.

13. The apparatus of claim 1, wherein the EL lamp is constructed as a poker chip.

14. The apparatus of claim 1, wherein the EL lamp is constructed as a removable switchless room display.

15. The apparatus of claim 1, wherein the EL lamp is constructed as a credit card and credit card holder.

16. The apparatus of claim 1, wherein the EL lamp is constructed as a label for a product.

17. The apparatus of claim 16, wherein the first coil is integrated into the product and the second coil is integrated into the shelving such that when the product is placed on the shelving the label associated with it is illuminated.

18. A method of illuminating a plurality of electroluminescent (EL) lamps separated from a power supply by a barrier, each EL lamp containing at least one secondary winding of a transformer, the method comprising the steps of:

supplying power from said power supply to a primary coil of a transformer, the primary coil of the transformer being separated from the EL lamps by the barrier;

receiving magnetic flux at the secondary windings of the EL lamps, the magnetic flux being generated by the primary winding in response to the step of supplying power;

inducing a current in the secondary windings by the received magnetic flux

supplying the current to the EL lamps.

19. The method of claim 18, the step of supplying power from the power supply including the step of varying the frequency of the power from the power supply to change the illuminated EL lamp color.

20. The method of claim 18, wherein the step of supplying the current to the EL lamps comprises supplying the current to the EL lamps through a microprocessor which is configured to sequence through the plurality of EL lamps.

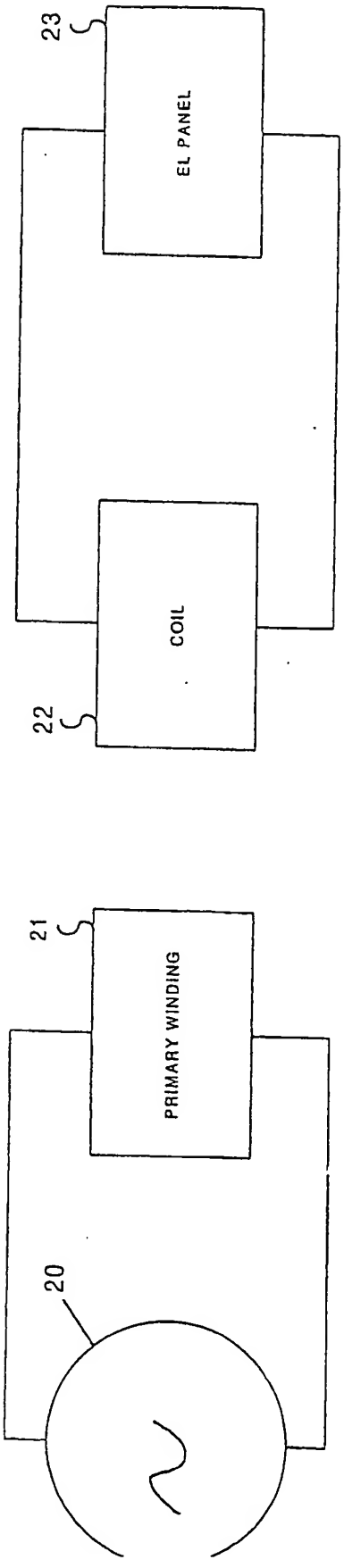


Fig. 1

Fig. 2a

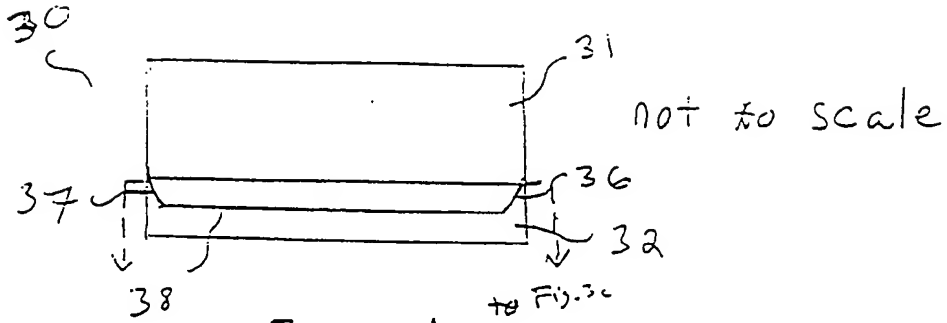


Fig. 2b

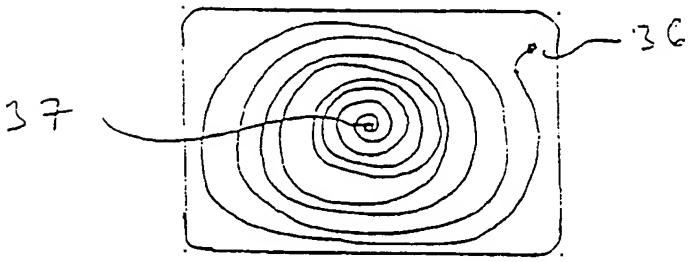


Fig. 2c

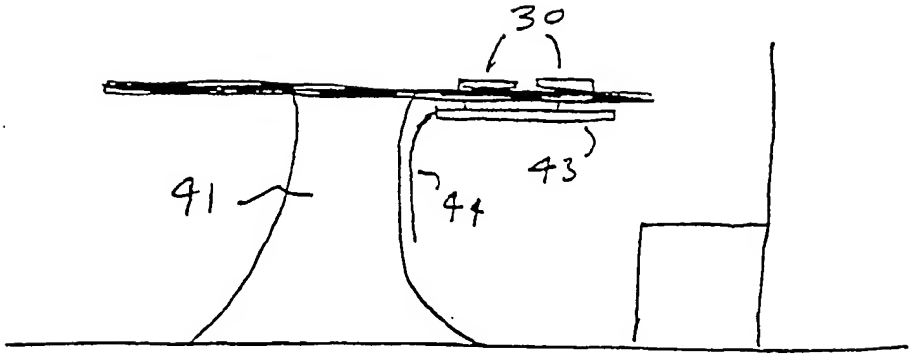


Fig. 3

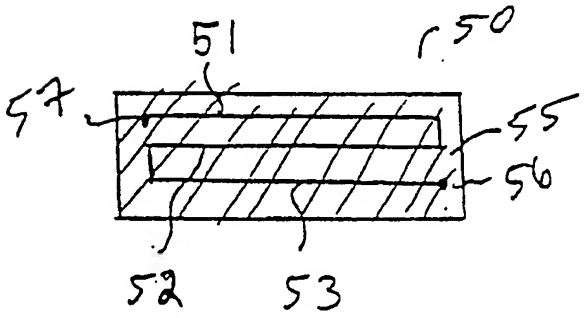


Fig. 4

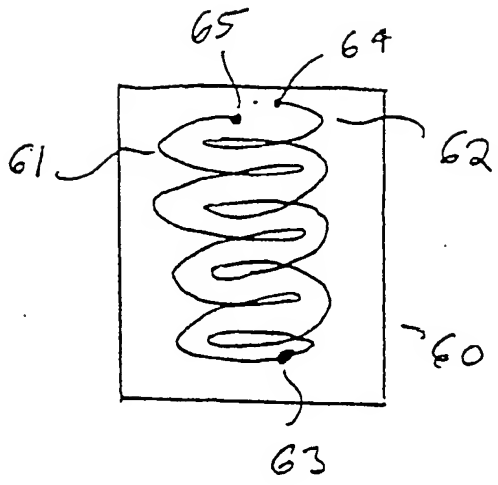
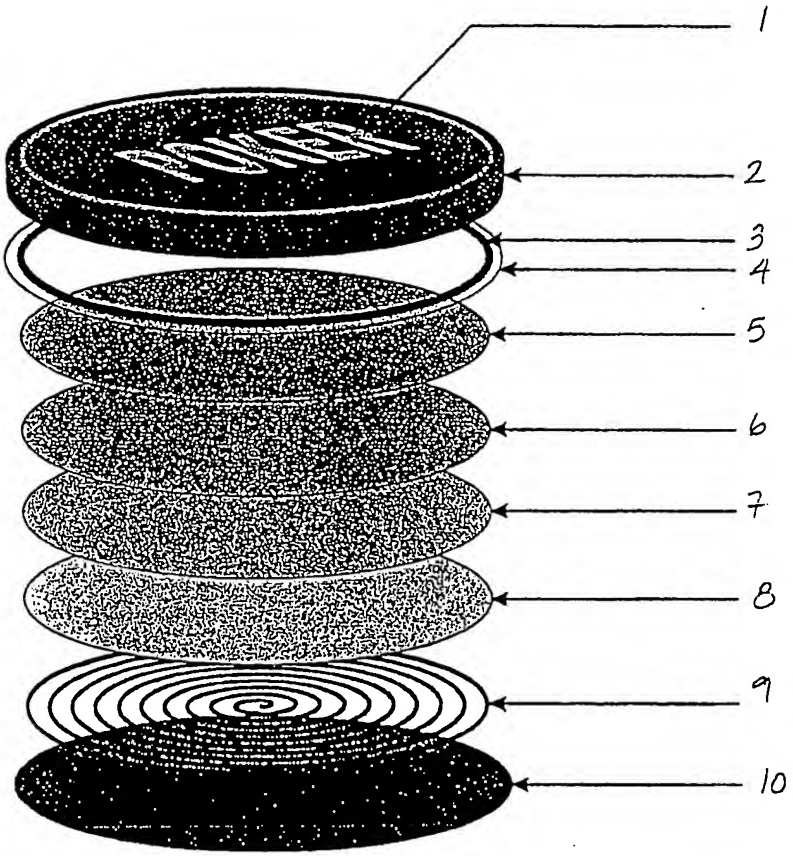


Fig. 5

INDUCTIVE EL POKER CHIP



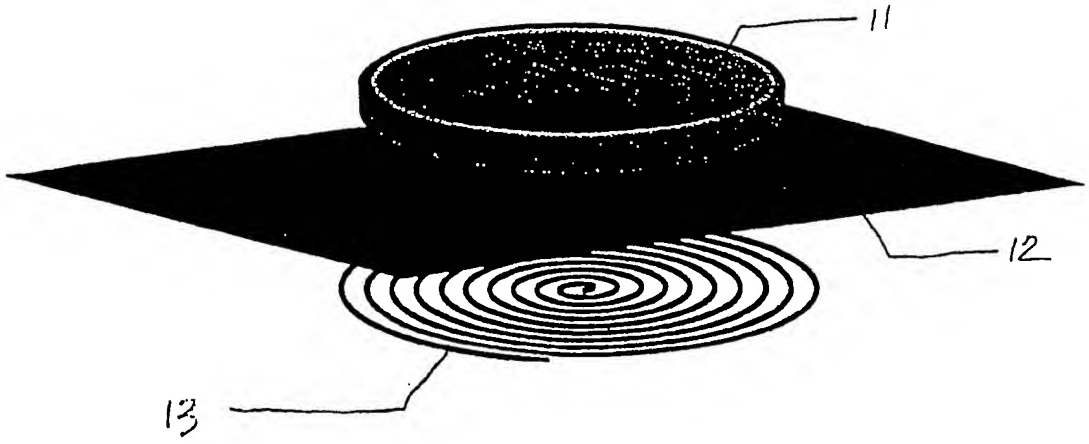


Fig 6

METHOD FOR PRINTING INDUCTIVE COIL
(shape variation)

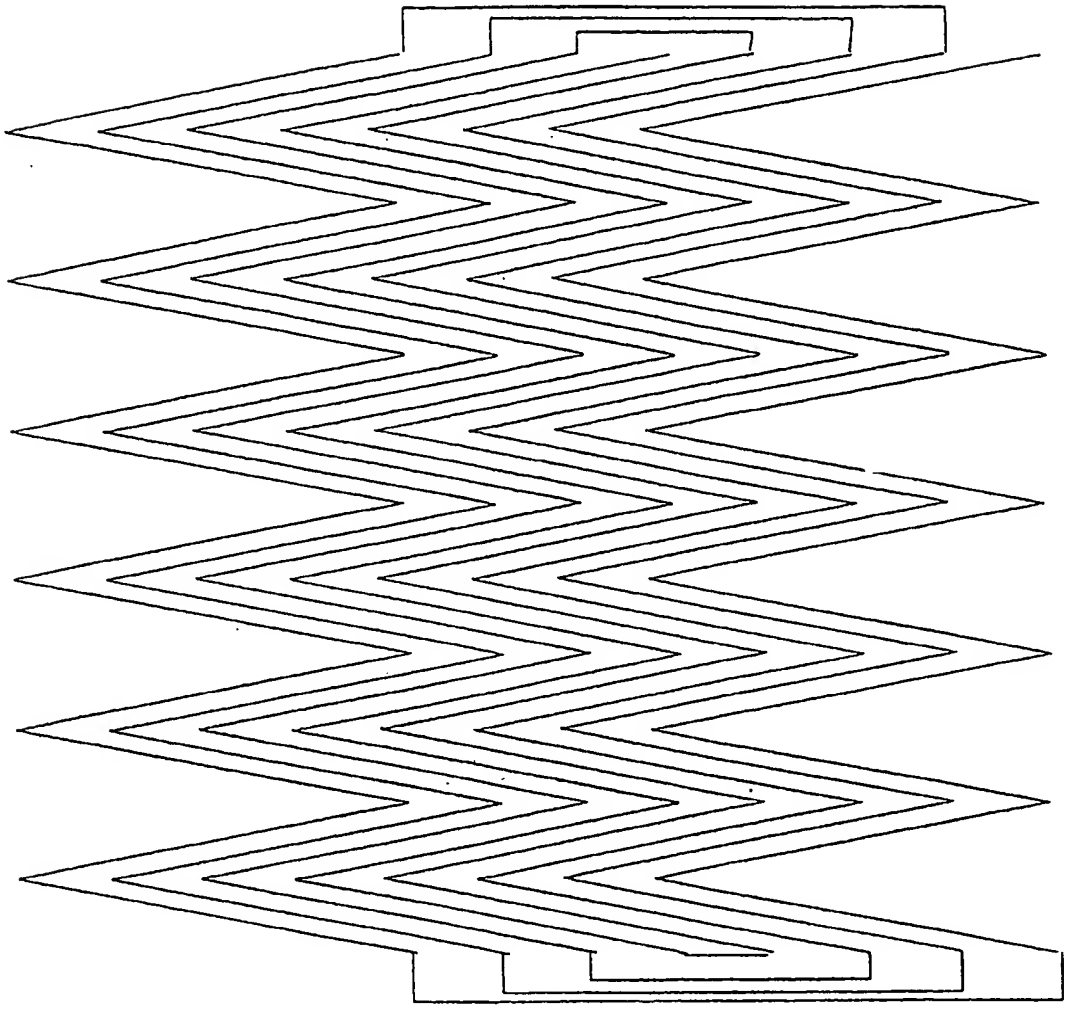


Fig. 7

METHOD FOR SEQUENCING INDUCTIVE COILS FOR POWERING AN INDUCTIVE EL ASSEMBLY

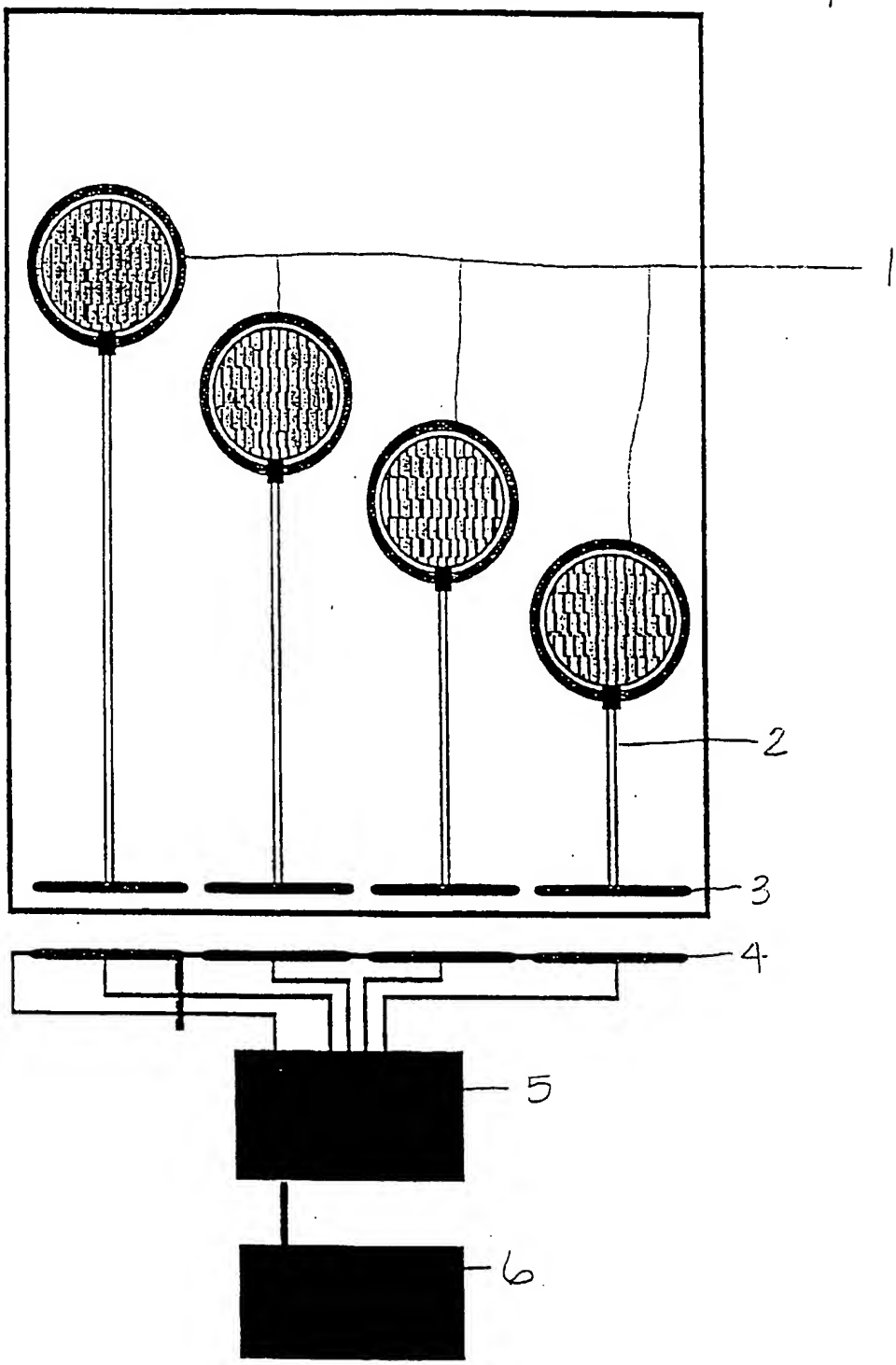


Fig 8

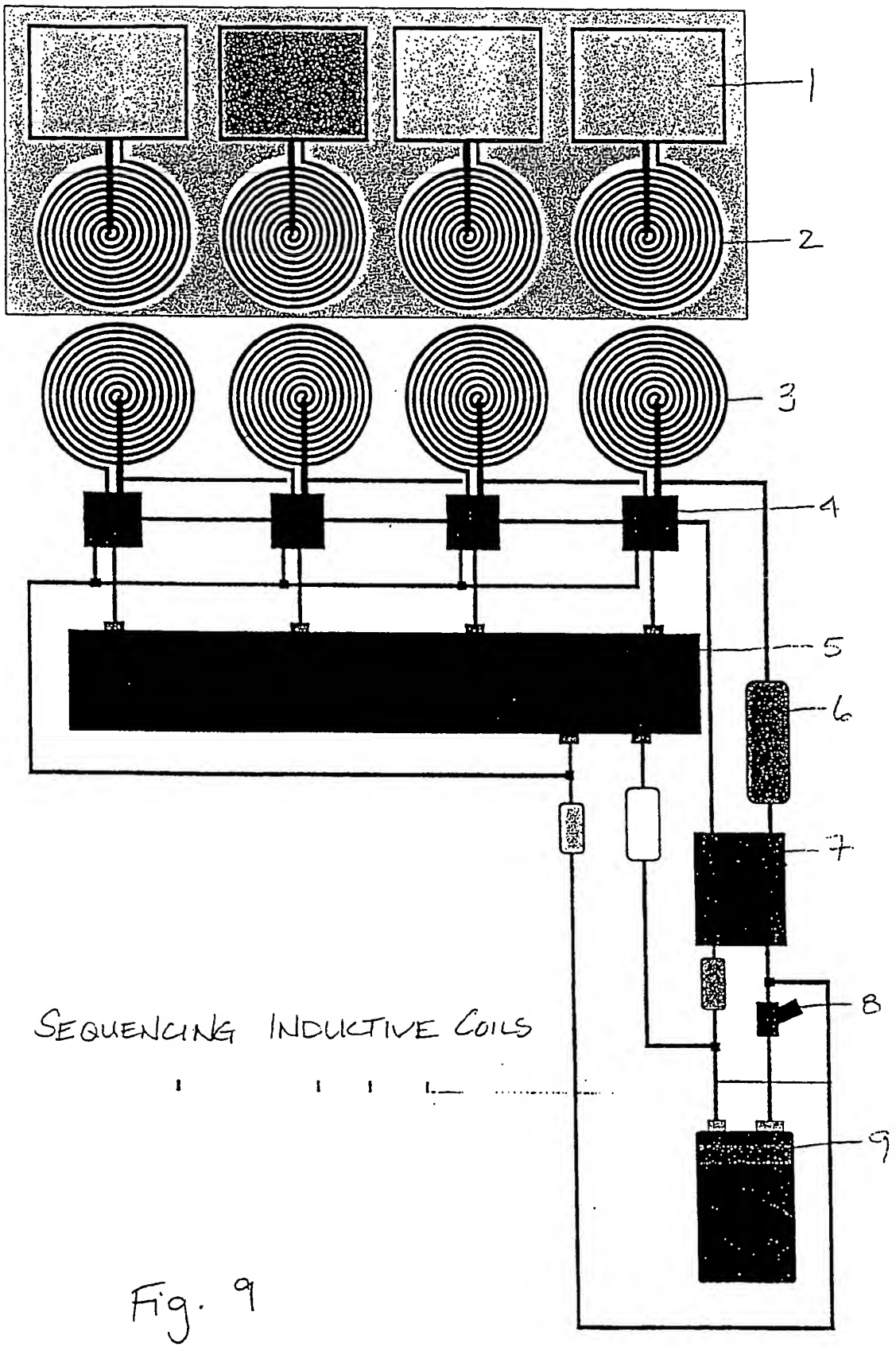


Fig. 9

Printed Coil

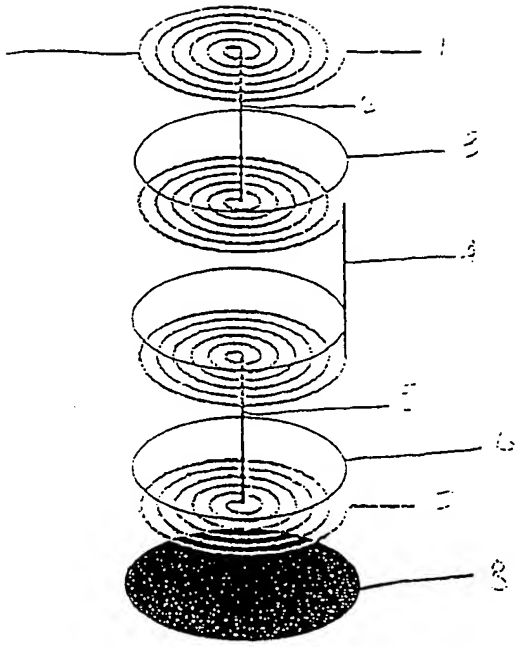


Fig. 10

INDUCTIVE ELECTROLUMINESCENT ROOM DISPLAY
DETAIL

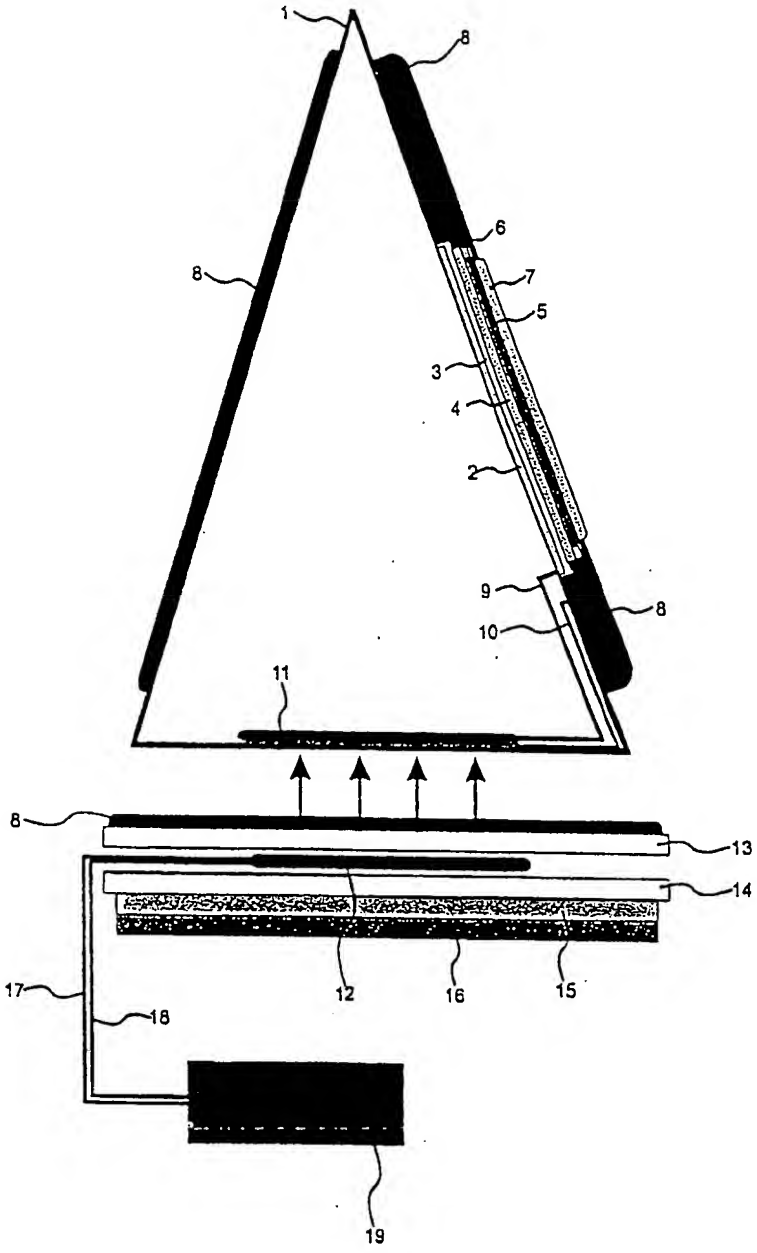


Fig 11

INDUCTIVE ELECTROLUMINESCENT ROOM DISPLAY

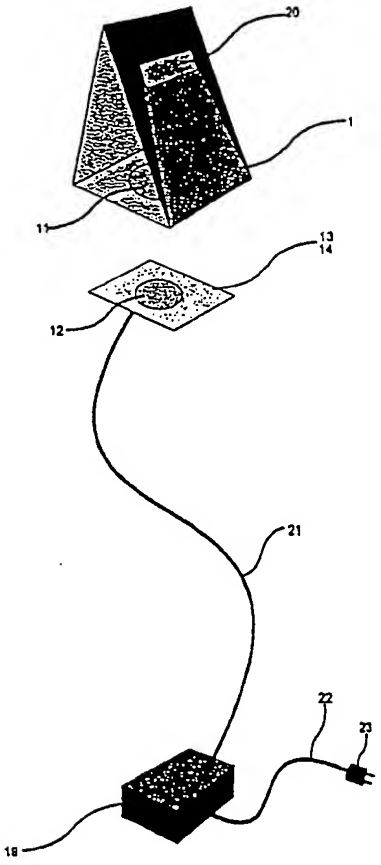


Fig 12

Coil Card

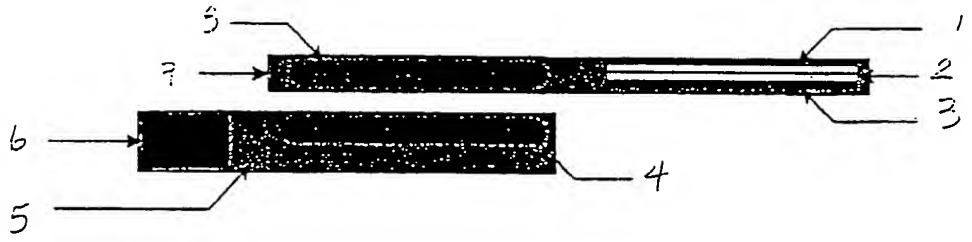


Fig 13

INDUCTIVE ELECTROLUMINESCENT CREDIT CARD WALLET

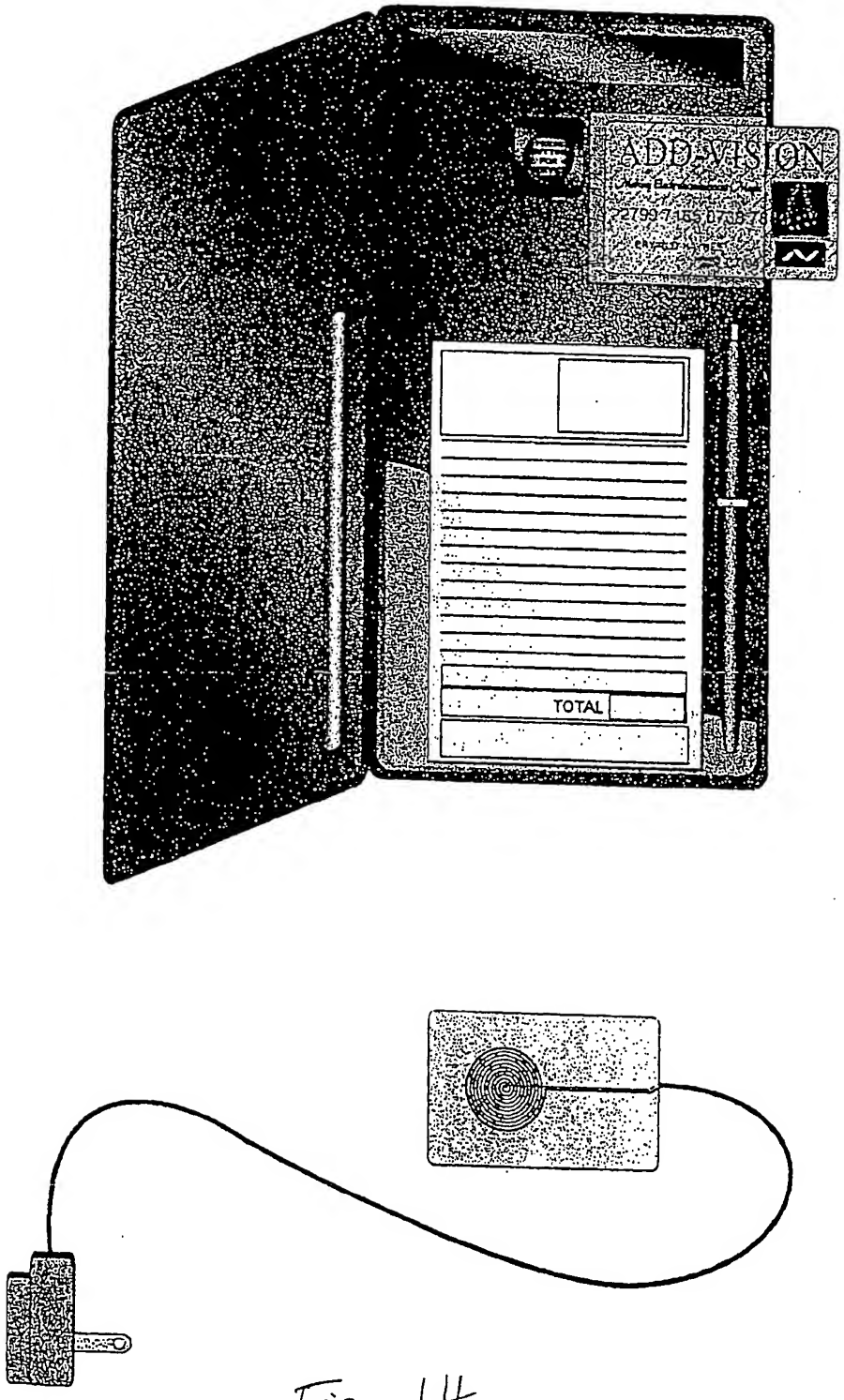
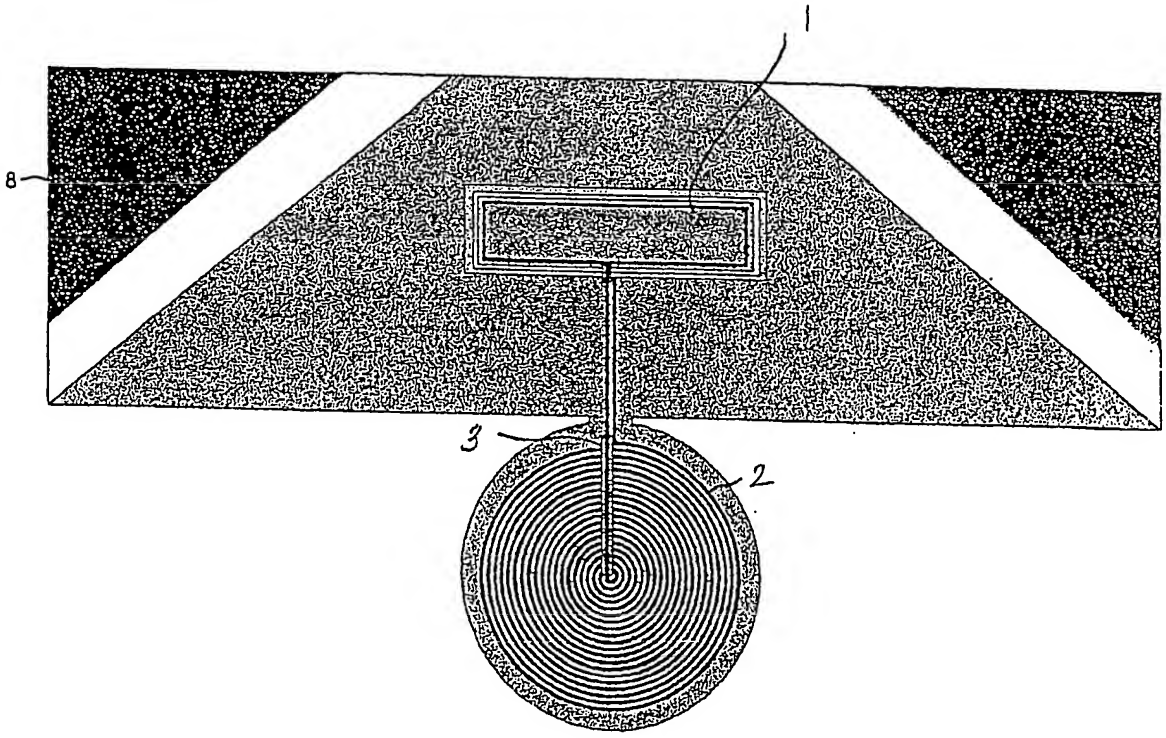


Fig. 14

CoilCan



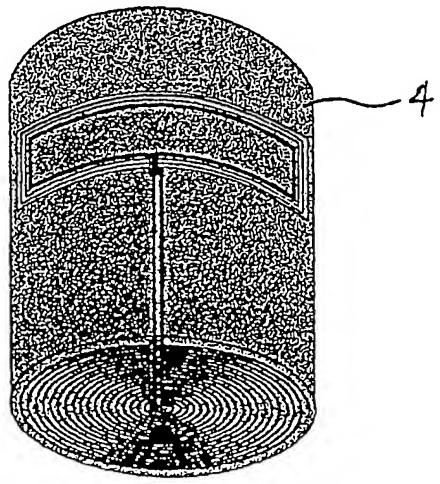


Fig. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/22798

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :H01J 63/04, 1/62

US CL :313/512, 510, 509, 506, 505; 362/206, 105, 84, 189, 194

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 313/512, 510, 509, 506, 505; 362/206, 105, 84, 189, 194

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,845,987 A (PAINTER) 08 December 1998 (08.12.1998), entire document.	1-6, 16-20 ------ 7-15
Y	US 5,821,691 A (RICHIE et al) 13 October 1998 (13.10.1998), entire document.	7-10, 12-15
Y	US 3,571,647 A (ROBINSON) 23 March 1971 (23.03.1971) col. 2, lines 57-60.	11

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 31 OCTOBER 2000	Date of mailing of the international search report 28 NOV 2000
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